

# ESD Protection Diodes

## Ultra Low Capacitance ESD Protection Diode for High Speed Data Line

### ESD8101, ESD8111

The ESD81x1 Series ESD protection diodes are designed to protect high speed data lines from ESD. Ultra-low capacitance and low ESD clamping voltage make this device an ideal solution for protecting voltage sensitive high speed data lines.

#### Features

- Low Capacitance (0.20 pF Typ, I/O to GND)
- Protection for the Following IEC Standards:  
IEC 61000-4-2 (Level 4)
- Low ESD Clamping Voltage
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Typical Applications

- USB 3.0/3.1
- MHL 2.0
- eSATA

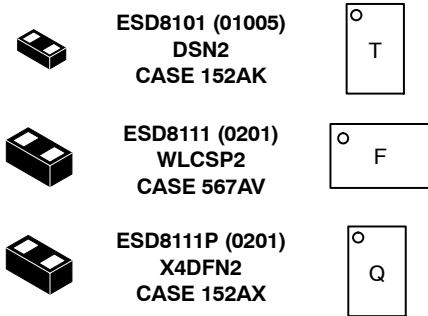
#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating                                                 | Symbol    | Value       | Unit             |
|--------------------------------------------------------|-----------|-------------|------------------|
| Operating Junction Temperature Range                   | $T_J$     | -55 to +150 | $^\circ\text{C}$ |
| Storage Temperature Range                              | $T_{stg}$ | -55 to +150 | $^\circ\text{C}$ |
| Lead Solder Temperature – Maximum (10 Seconds)         | $T_L$     | 260         | $^\circ\text{C}$ |
| ESD8101:<br>IEC 61000-4-2 Contact<br>IEC 61000-4-2 Air | ESD       | $\pm 23$    | kV               |
| ESD8111:<br>IEC 61000-4-2 Contact<br>IEC 61000-4-2 Air |           | $\pm 30$    | kV               |
|                                                        |           | $\pm 30$    | kV               |
|                                                        |           | $\pm 30$    | kV               |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

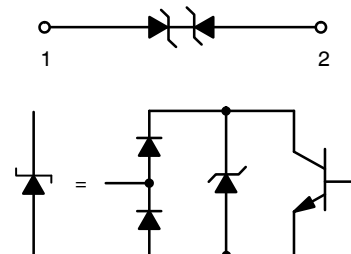
See Application Note AND8308/D for further description of survivability specs.

#### MARKING DIAGRAMS



T, F, Q = Device Code

#### PIN CONFIGURATION AND SCHEMATIC



#### ORDERING INFORMATION

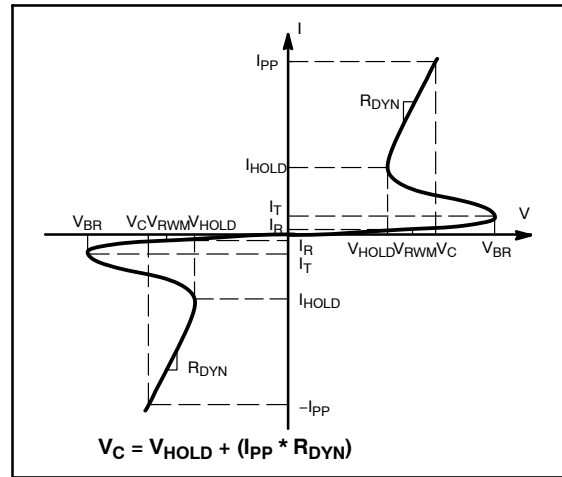
See detailed ordering and shipping information on page 2 of this data sheet.

# ESD8101, ESD8111

## ELECTRICAL CHARACTERISTICS

(T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol            | Parameter                                                                                                        |
|-------------------|------------------------------------------------------------------------------------------------------------------|
| V <sub>RWM</sub>  | Working Peak Voltage                                                                                             |
| I <sub>R</sub>    | Maximum Reverse Leakage Current @ V <sub>RWM</sub>                                                               |
| V <sub>BR</sub>   | Breakdown Voltage @ I <sub>T</sub>                                                                               |
| I <sub>T</sub>    | Test Current                                                                                                     |
| V <sub>HOLD</sub> | Holding Reverse Voltage                                                                                          |
| I <sub>HOLD</sub> | Holding Reverse Current                                                                                          |
| R <sub>DYN</sub>  | Dynamic Resistance                                                                                               |
| I <sub>PP</sub>   | Maximum Peak Pulse Current                                                                                       |
| V <sub>C</sub>    | Clamping Voltage @ I <sub>PP</sub><br>V <sub>C</sub> = V <sub>HOLD</sub> + (I <sub>PP</sub> * R <sub>DYN</sub> ) |



## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise specified)

| Parameter                                      | Symbol            | Conditions                                                                               | Min | Typ  | Max | Unit |
|------------------------------------------------|-------------------|------------------------------------------------------------------------------------------|-----|------|-----|------|
| Reverse Working Voltage                        | V <sub>RWM</sub>  | I/O Pin to GND                                                                           |     |      | 3.3 | V    |
| Breakdown Voltage                              | V <sub>BR</sub>   | I <sub>T</sub> = 1 mA, I/O Pin to GND                                                    | 5.5 | 7.9  | 8.6 | V    |
| Reverse Leakage Current                        | I <sub>R</sub>    | V <sub>RWM</sub> = 3.3 V, I/O Pin to GND                                                 |     |      | 1.0 | μA   |
| Reverse Holding Voltage                        | V <sub>HOLD</sub> | I/O Pin to GND                                                                           |     | 2.1  |     | V    |
| Holding Reverse Current                        | I <sub>HOLD</sub> | I/O Pin to GND                                                                           |     | 17   |     | mA   |
| ESD8111 Clamping Voltage                       | V <sub>C</sub>    | I <sub>PP</sub> = 7.1 A, (8/20 μs pulse)                                                 |     |      | 8.0 | V    |
| ESD8101, ESD8111 Clamping Voltage TLP (Note 1) | V <sub>C</sub>    | I <sub>PP</sub> = 8 A } IEC 61000-4-2 Level 2 equivalent<br>(±4 kV Contact, ±4 kV Air)   |     | 6.5  |     | V    |
|                                                |                   | I <sub>PP</sub> = 16 A } IEC 61000-4-2 Level 4 equivalent<br>(±8 kV Contact, ±15 kV Air) |     | 10   |     | V    |
| Dynamic Resistance                             | R <sub>DYN</sub>  | I/O Pin to GND                                                                           |     | 0.46 |     | Ω    |
| Junction Capacitance                           | C <sub>J</sub>    | V <sub>R</sub> = 0 V, f = 1 MHz                                                          |     | 0.2  | 0.4 | pF   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. ANSI/ESD STM5.5.1 – Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model.

TLP conditions: Z<sub>0</sub> = 50 Ω, t<sub>p</sub> = 100 ns, t<sub>r</sub> = 4 ns, averaging window; t<sub>1</sub> = 30 ns to t<sub>2</sub> = 60 ns.

## ORDERING INFORMATION

| Device        | Package                                     | Shipping <sup>†</sup> |
|---------------|---------------------------------------------|-----------------------|
| ESD8101FCT5G  | DSN2<br>(Pb-Free)                           | 10,000 / Tape & Reel  |
| ESD8111FCT5G  | WLCSP2<br>(Pb-Free)                         | 10,000 / Tape & Reel  |
| ESD8111PFCT5G | WLCSP2 Side wall Isolated 0201<br>(Pb-Free) | 10,000 / Tape & Reel  |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# ESD8101, ESD8111

## TYPICAL CHARACTERISTICS

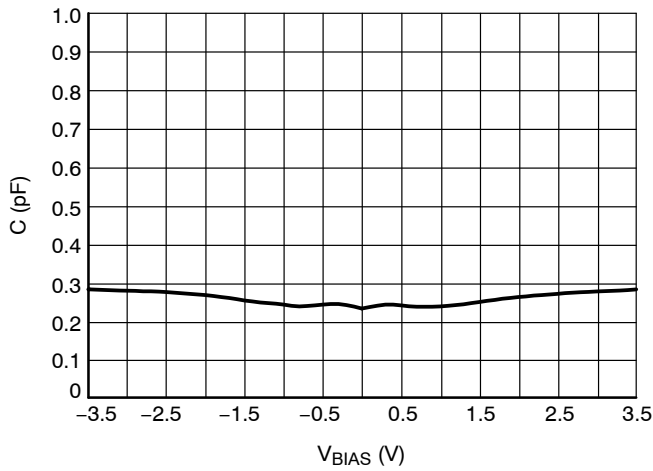


Figure 1. ESD8101 CV Characteristics

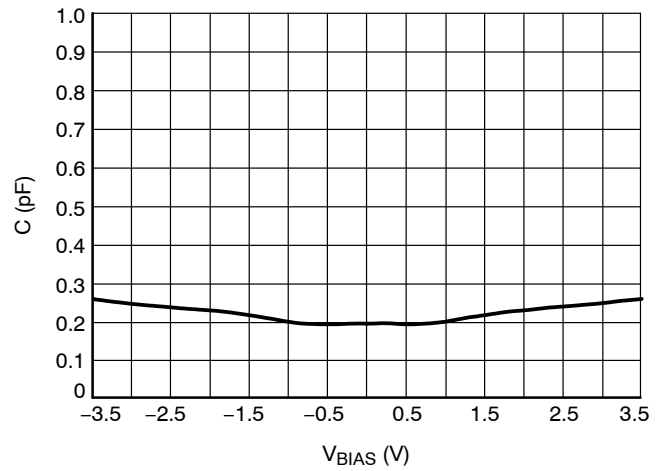


Figure 2. ESD8111 CV Characteristics

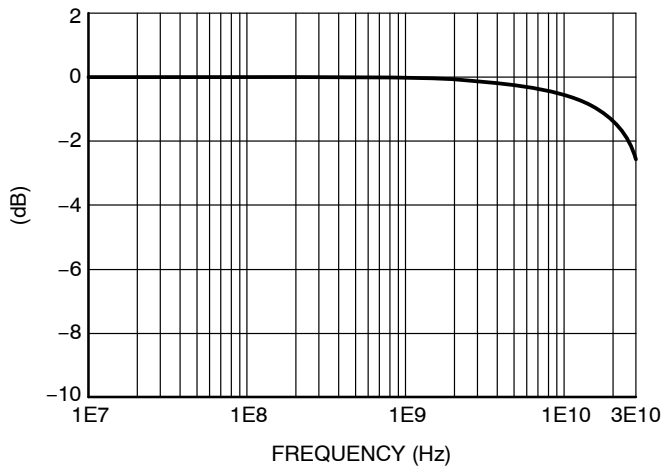


Figure 3. ESD8101 S21 Insertion Loss

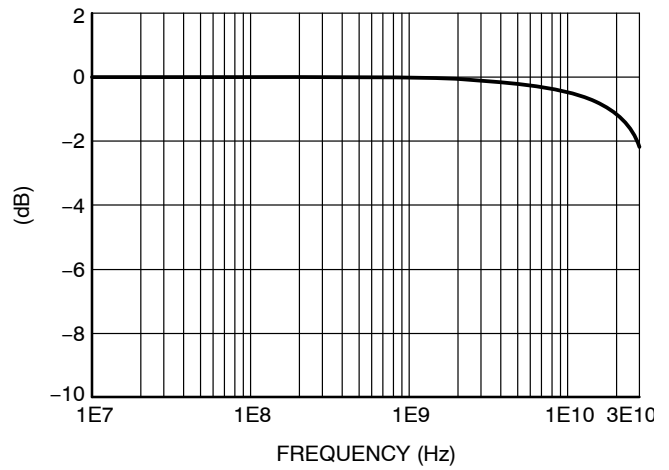


Figure 4. ESD8111 S21 Insertion Loss

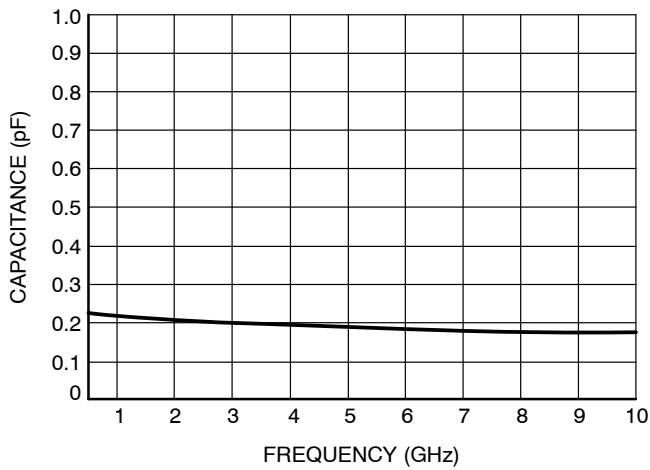


Figure 5. ESD8101 Capacitance over Frequency

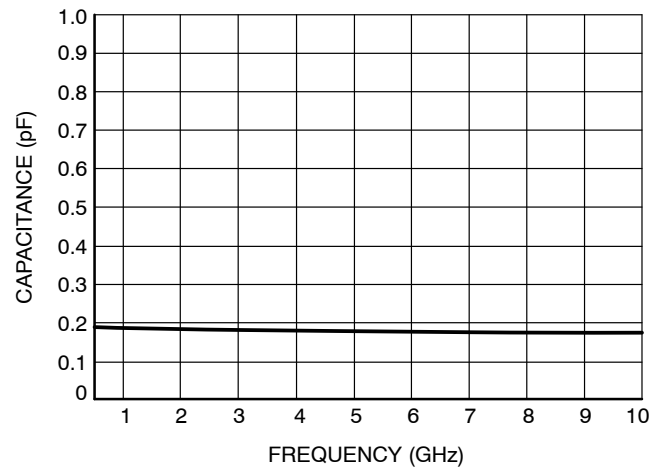


Figure 6. ESD8111 Capacitance over Frequency

# ESD8101, ESD8111

## TYPICAL CHARACTERISTICS

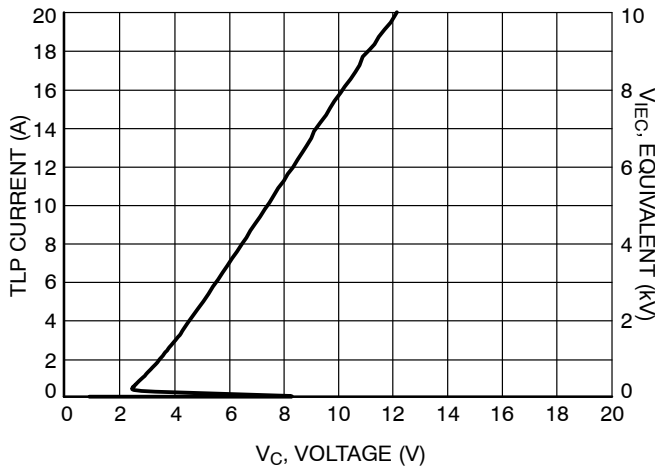


Figure 7. ESD8101 Positive TLP I-V Curve

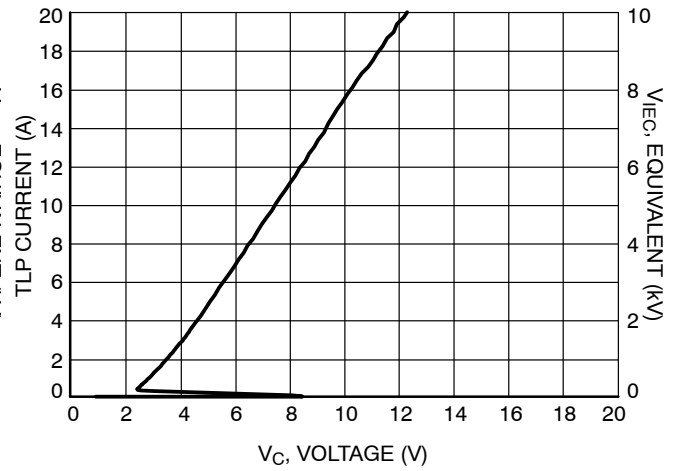


Figure 8. ESD8111 Positive TLP I-V Curve

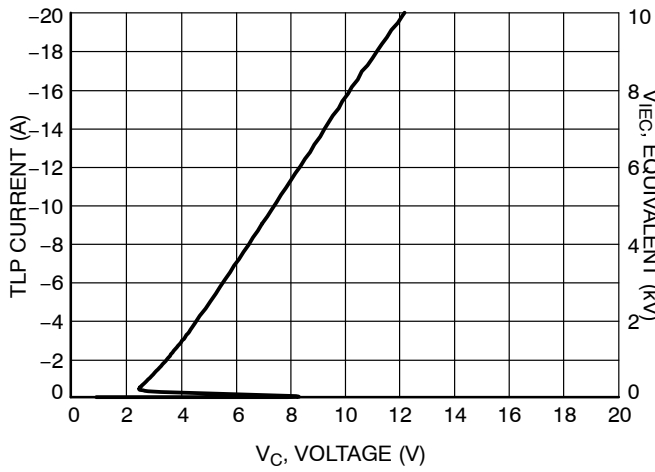


Figure 9. ESD8101 Negative TLP I-V Curve

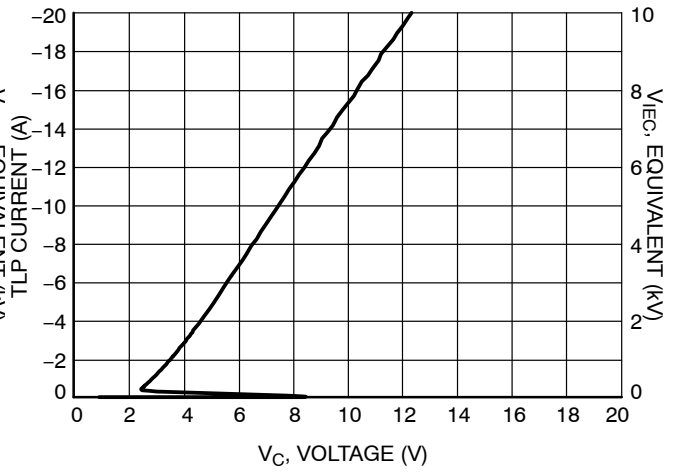


Figure 10. ESD8111 Negative TLP I-V Curve

## ESD8101, ESD8111

### IEC 61000-4-2 Spec.

| Level | Test Voltage (kV) | First Peak Current (A) | Current at 30 ns (A) | Current at 60 ns (A) |
|-------|-------------------|------------------------|----------------------|----------------------|
| 1     | 2                 | 7.5                    | 4                    | 2                    |
| 2     | 4                 | 15                     | 8                    | 4                    |
| 3     | 6                 | 22.5                   | 12                   | 6                    |
| 4     | 8                 | 30                     | 16                   | 8                    |

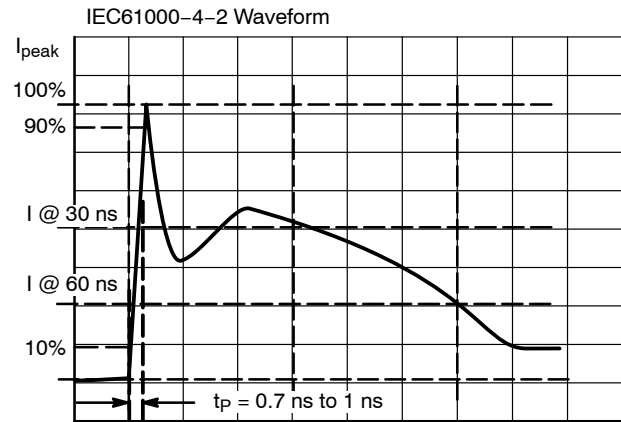


Figure 11. IEC61000-4-2 Spec

### Transmission Line Pulse (TLP) Measurement

Transmission Line Pulse (TLP) provides current versus voltage (I-V) curves in which each data point is obtained from a 100 ns long rectangular pulse from a charged transmission line. A simplified schematic of a typical TLP system is shown in Figure 12. TLP I-V curves of ESD protection devices accurately demonstrate the product's ESD capability because the 10s of amps current levels and under 100 ns time scale match those of an ESD event. This is illustrated in Figure 13 where an 8 kV IEC 61000-4-2 current waveform is compared with TLP current pulses at 8 A and 16 A. A TLP I-V curve shows the voltage at which the device turns on as well as how well the device clamps voltage over a range of current levels.

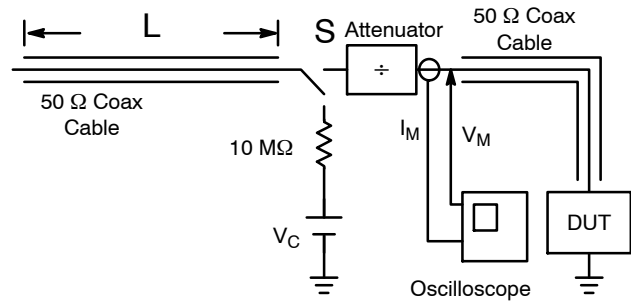


Figure 12. Simplified Schematic of a Typical TLP System

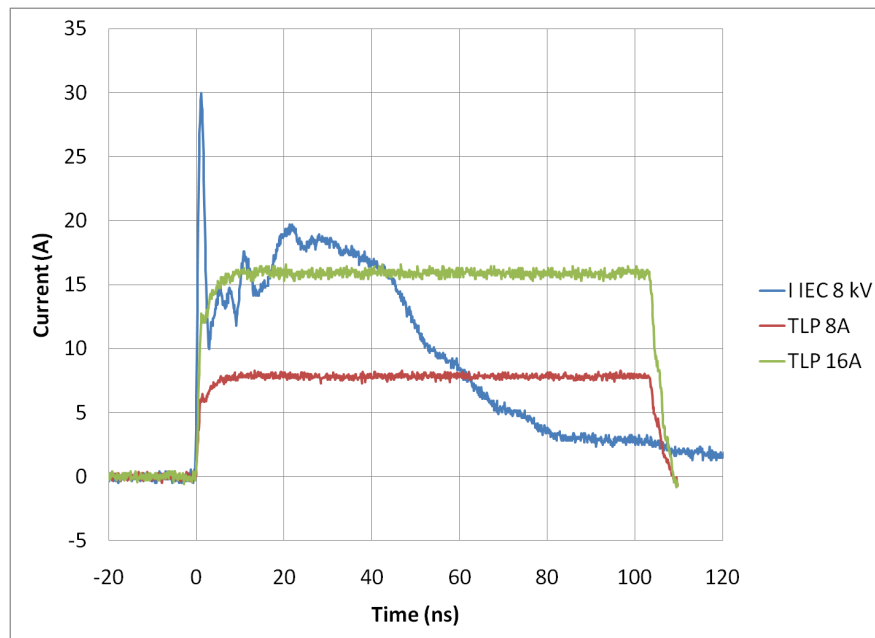


Figure 13. Comparison Between 8 kV IEC 61000-4-2 and 8 A and 16 A TLP Waveforms

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

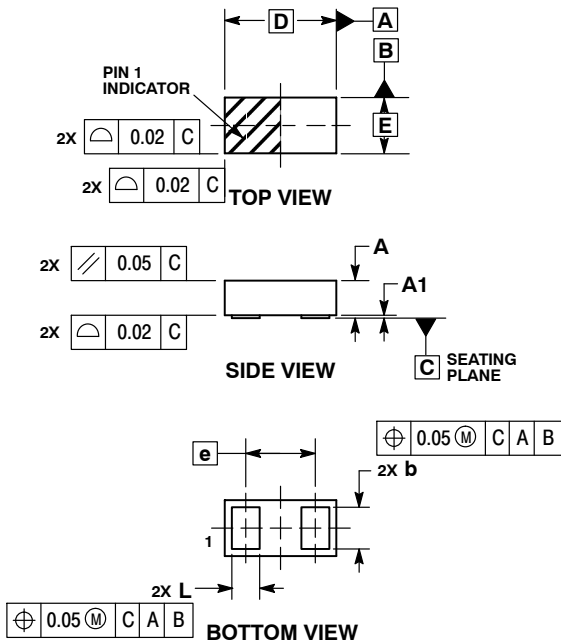
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SCALE 16:1

DSN2, 0.435x0.23, 0.27P, (01005)  
CASE 152AK  
ISSUE A

DATE 17 FEB 2015



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.

| MILLIMETERS |           |       |
|-------------|-----------|-------|
| DIM         | MIN       | MAX   |
| A           | 0.165     | 0.195 |
| A1          | ---       | 0.030 |
| b           | 0.177     | 0.193 |
| D           | 0.435 BSC |       |
| E           | 0.230 BSC |       |
| e           | 0.270 BSC |       |
| L           | 0.112     | 0.128 |

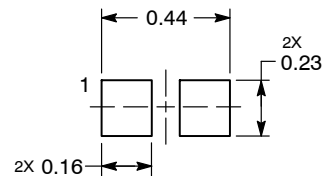
### GENERIC MARKING DIAGRAM\*



X = Specific Device Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present.

### RECOMMENDED SOLDER FOOTPRINT\*

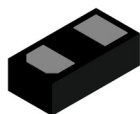


DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

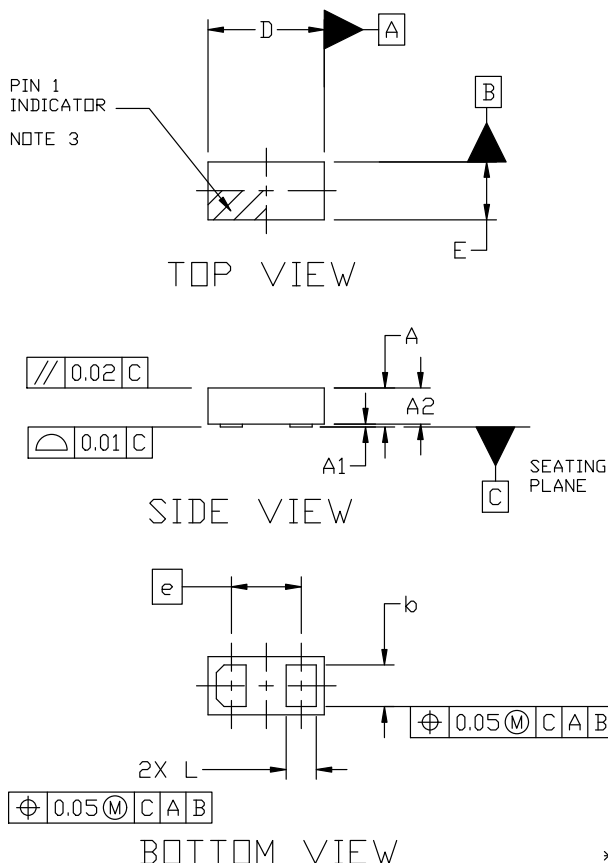
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**X4DFN2, 0.60x0.30x0.19, 0.36P**  
CASE 152AX  
ISSUE H

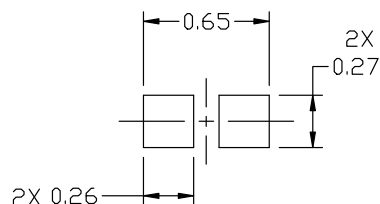
DATE 01 AUG 2023



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS

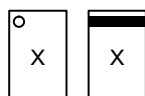
| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN.        | NOM.  | MAX.  |
| A   | 0.175       | 0.200 | 0.225 |
| A1  | 0.018 REF   |       |       |
| A2  | 0.180       | 0.190 | 0.200 |
| b   | 0.205       | 0.215 | 0.225 |
| D   | 0.575       | 0.600 | 0.625 |
| E   | 0.275       | 0.300 | 0.325 |
| e   | 0.36 BSC    |       |       |
| L   | 0.145       | 0.155 | 0.165 |



**RECOMMENDED  
MOUNTING FOOTPRINT**

- \* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

### GENERIC MARKING DIAGRAM\*



X = Specific Device Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present. Some products may not follow the Generic Marking.

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# MECHANICAL CASE OUTLINE

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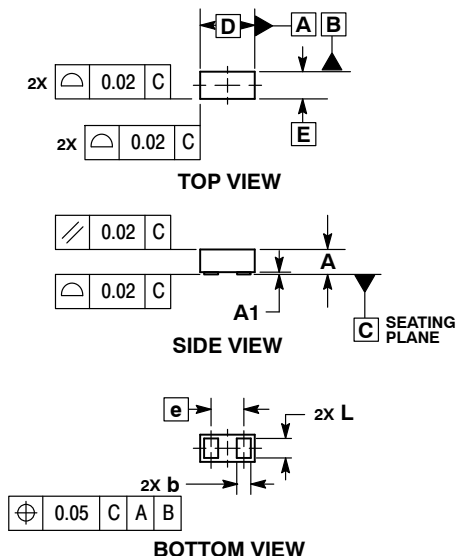
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SCALE 12:1

WLCSP2, 0.6x0.3  
CASE 567AV  
ISSUE C

DATE 22 SEP 2017



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.

| MILLIMETERS |          |       |       |
|-------------|----------|-------|-------|
| DIM         | MIN      | NOM   | MAX   |
| A           | 0.250    | 0.275 | 0.300 |
| A1          | 0.000    | 0.025 | 0.050 |
| b           | 0.140    | 0.155 | 0.170 |
| D           | 0.570    | 0.600 | 0.630 |
| E           | 0.270    | 0.300 | 0.330 |
| e           | 0.36 BSC |       |       |
| L           | 0.190    | 0.215 | 0.240 |

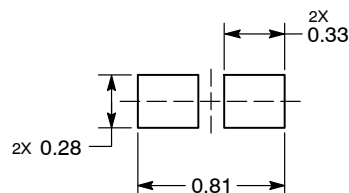
### GENERIC MARKING DIAGRAM\*



X = Specific Device Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

### RECOMMENDED SOLDER FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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